Release July, 2017

TEST REPORT

N°: 162484-739650-B (File #1007666) **Version : 04**

Subject	**Electromagnetic compatibility tests according to the standards:** **FCC CFR 47 Part 15, Subpart B and C** **RSS-210 Issue 9**
Issued to	**ISKN** 22 avenue Benoit Frachon 38400 St Martin d'Hères, France

Apparatus under test

Product	Smart Device
Trade mark	**ISKN**
Manufacturer	**ISKN**
Model under test	**TB1E1**
Serial number	**200228 / 200230**
FCCID	**2ACQC – TB1E1**
IC	**12188A – TB1E1**

Conclusion	See Test Program chapter
Test date	July 24, 2019 to August 1, 2019
Test location	FONTENAY AUX ROSES
IC Test site	6230B-1
Composition of document	38 pages
Document issued on	January 14, 2020

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PUBLICATION HISTORY

Version	Date	Author	Modification
01	August 6, 2019	Majid MOURZAGH	Creation of the document
02	September 16, 2019	Majid MOURZAGH	Modification about IC
03	November 8, 2019	Majid MOURZAGH	Modification about FCCID/Model
04	January 14, 2020	Majid MOURZAGH	Correction tabs peak and average separately

SUMMARY

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1. TEST PROGRAM

Standard:

- **FCC Part 15, Subpart B and C**
- **FCC Part15 §15.225**
- **ANSI C63.10 (2013)**
- **ANSI C63.4 (2014)**
- **RSS-210 Issue 9**
- **RSS-Gen Issue 5**

EMISSION TEST	LIMITS			RESULTS (Comments)
Limits for conducted disturbance at mains ports 150kHz-30MHz *CFR 47 §15.107 and 15.207*	**Frequency**	**Quasi-peak value (dBµV)**	**Average value (dBµV)**	☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
	150-500kHz	66 to 56	56 to 46	
	0.5-5MHz	56	46	
	5-30MHz	60	50	
Radiated emissions 9kHz-30MHz *CFR 47 §15.209 (a)* *CFR 47 §15.225* *RSS-Gen §4.9*	**Measure at 300m** 9kHz-490kHz : 67.6dBµV/m /F(kHz) **Measure at 30m** 490kHz-1.705MHz : 87.6dBµV/m /F(kHz) 1.705MHz-30MHz : 29.5 dBµV/m			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Radiated emissions 30MHz-25GHz* *CFR 47 §15.109 and 15.209 (a)* *CFR 47 §15.225* *RSS-Gen §4.9* ***Highest frequency : 216MHz (Declaration of provider)***	**Measure at 3m** 30MHz-88MHz : 40 dBµV/m 88MHz-216MHz : 43.5 dBµV/m 216MHz-960MHz : 46.0 dBµV/m Above 960MHz : 54.0 dBµV/m			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Fundamental field strength limit *CFR 47 §15.225* *RSS-210 §B.6*	**Operation within the band 13.110-14.010 MHz**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Fundamental frequency tolerance *CFR 47 §15.225* *RSS-210 §B.6*	**Operation within the band 13.110-14.010 MHz**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Band edge compliance *CFR 47 §15.225* *RSS-210 §B.6*	**Operation within the band 13.110-14.010 MHz**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Occupied bandwidth *RSS-Gen Issue 5 §6.7*	**No limit**			☑ **PASS** ☐ **FAIL** ☐ **NA** ☐ **NP**
Receiver Spurious Emission** *RSS-Gen Issue 5 §7.3*	**See RSS-Gen §7.3**			☐ **PASS** ☐ **FAIL** ☑ **NA** ☐ **NP**

***§15.33:** The highest internal source of a testing device is defined like more the highest frequency generated or used in the testing device or on which the testing device works or agrees.
- If the highest frequency of the internal sources of the testing device is lower than 108 MHz, measurement must be only performed until 1GHz.
- If the highest frequency of the internal sources of the testing device ranges between 108 MHz and 500 MHz, measurement must be only performed until 2GHz.
- If the highest frequency of the internal sources of the testing device ranges between 500 MHz and 1 GHz, measurement must be only performed until 5GHz.

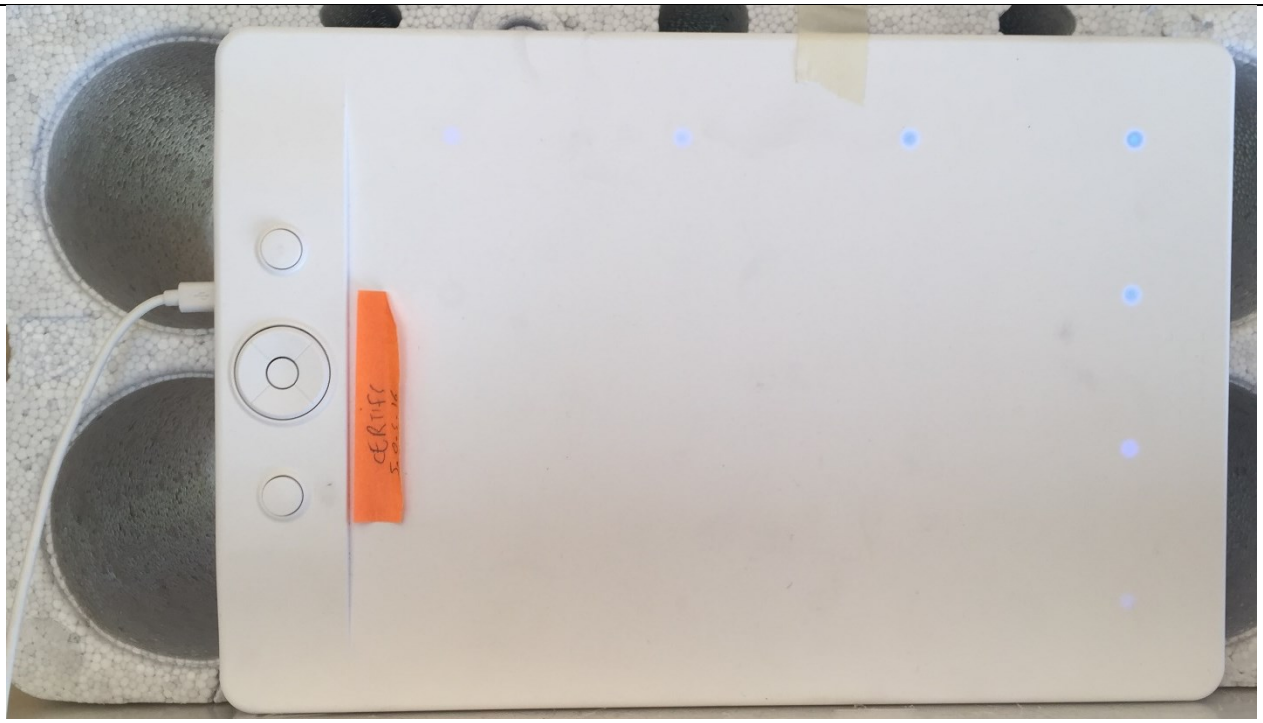
If the highest frequency of the internal sources of the testing device is above 1 GHz, measurement must be only performed until 5 times the highest frequency or 40 GHz, while taking smallest of both.

**Testing covered the receive mode, and receiver spurious emissions are considered to be the same as transmitter.

2. SYSTEM TEST CONFIGURATION

2.1. HARDWARE IDENTIFICATION (EUT AND AUXILIARIES):

Equipment under test (EUT):
TB1E1
Serial Number: 200230



Photography of EUT

Power supply:
During all the tests, EUT is supplied by V_{nom}3.7Vdc
For measurement with different voltage, it will be presented in test method.

Name	Type	Rating	Reference / Sn	Comments
Supply1	☐ AC ☐ DC ☑ Battery ☐USB	3.7Vdc	/	/
Supply2	☐ AC ☐ DC ☐ Battery ☑USB	5Vusb	/	/

Voltage table used:

Type	Measurement performed:	
☐ AC	☐ **120VAC/60Hz**	☐ **240VAC/50Hz**
☐ DC	☐ **+....VDC**	☐ **-....VDC**
☑ Battery	☑ **+3.7VDC**	☐ **-....VDC**
☑ USB (Laptop auxiliary)	☑ **120VAC/60Hz (Laptop auxiliary)**	☑ **240VAC/50Hz(Laptop auxiliary)**

Inputs/outputs - Cable:

Access	Type	Length used (m)	Declared <3m	Shielded	Under test	Comments
µUSB	USB	1	☐	☑	☑	/

Auxiliary equipment used during test:

Type	Reference	Sn	Comments
Laptop	DELL Latitude E5530	/	/
AC Adapter for Laptop	DELL LA65NS0-00	/	Input: AC 100-240V (1.5A) Output: DC 19.5V(3.34A)
Power supply AC/DC	KEYSIGHT	AC6802A	A7042305

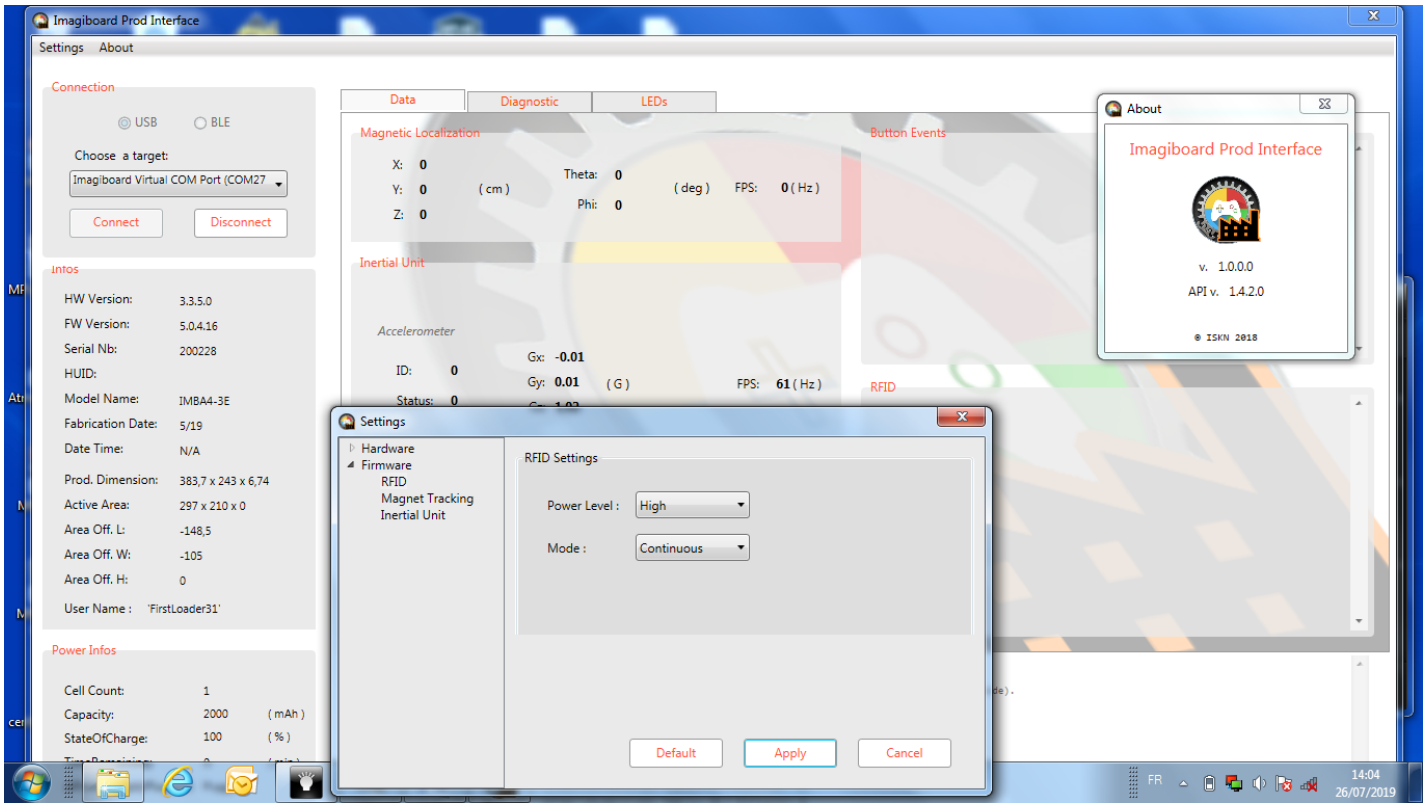
Equipment information:

Frequency band:	☑ [13.553–13.567]MHz	☐ [125]kHz	☐ [-] MHz	
RF mode:	☐ Transmitter	☑ Transceiver	☐ Receiver	☐ Standby
Type:	☑ RFID	☐ EAS	☐ Other:	
Bandwidth:	☐ Narrowband (ISO15693, ISO18000-3…)		☑ Wideband (ISO14443, NFC…)	
Product class – Annex B.2	☐ 1	☐ 2	☑ 3	☐ 4
Channelized system:	☑ No	☐ Yes, channel spacing: kHz		
Equipment intended for use as a	☐ Fixed	☐ Mobile	☑ Portable	
Type of equipment:	☑ Stand-alone	☐ Plug-in	☐ Combined	
Antenna Type:	☐ External		☑ Internal	
Antenna connector:	☐ Permanent external	☑ Permanent internal	☐ None	☐ Temporary (only for tests)
Antenna Gain:	0 dBi			
Duty cycle:	☑ Continuous duty	☐ Intermittent duty	☐ Continuous operation	
Equipment type:	☑ Production model		☐ Prototype	
Temperature range:	Tmin:	☐ -20°C	☑ 0°C	☐ °C
	Tnom:	20°C		
	Tmax:	☑ 35°C	☐ 55°C	☐ °C
Type of power source:	☐ AC power supply	☐ DC power supply	☑ Battery (Lithium)	
Test source voltage:	Vmin:	☐ 207V/50Hz	☑ 3.1 VDC	
	Vnom:	☐ 230V/50Hz	☑ 3.7 VDC	
	Vmax	☐ 253V/50Hz	☑ 4.3 VDC	

Nc: Not communicated

2.2. EUT CONFIGURATION

Hardware information		
Firmware (if applicable):	V. :	3.3.5.0
Software (if applicable):	V. :	5.0.4.16
/		



2.3. EQUIPMENT MODIFICATIONS

☑ None ☐ Modification:

2.4. FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follow:

FS = RA + AF + CF – AG

Where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Factor
AG = Amplifier Gain

Assume a receiver reading of 52.5dBµV is obtained. The antenna factor of 7.4 and a cable factor of 1.1 are added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dBµV/m.
FS = 52.5 + 7.4 + 1.1 – 29 = 32 dBµV/m
The 32 dBµV/m value can be mathematically converted to its corresponding level in µV/m.
Level in µV/m = Common Antilogarithm [(32dBµV/m)/20] = 39.8 µV/m.

2.5. CALIBRATION DATE

The calibration intervals are extended at 12+2 months. This extended interval is based on the fact that there is sufficient calibration data to statistically establish a trend or based on experience of use of the test equipment to assure good measurement results for a longer period

3. CONDUCTED EMISSION DATA

3.1. ENVIRONMENTAL CONDITIONS

Date of test	:	July 30, 2019
Test performed by	:	Majid Mourzagh
Atmospheric pressure (hPa)	:	988
Relative humidity (%)	:	38
Ambient temperature (°C)	:	23

3.2. TEST SETUP

Mains terminals

The EUT and auxiliaries are set:

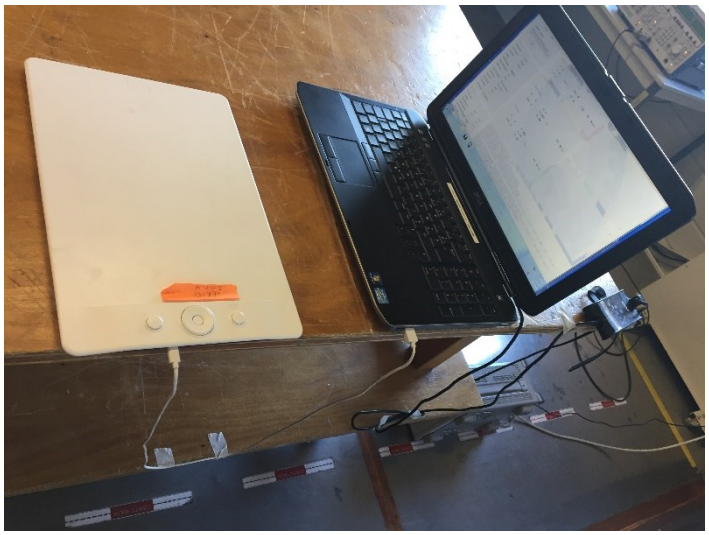
☑ 80cm above the ground on the non-conducting table (Table-top equipment)

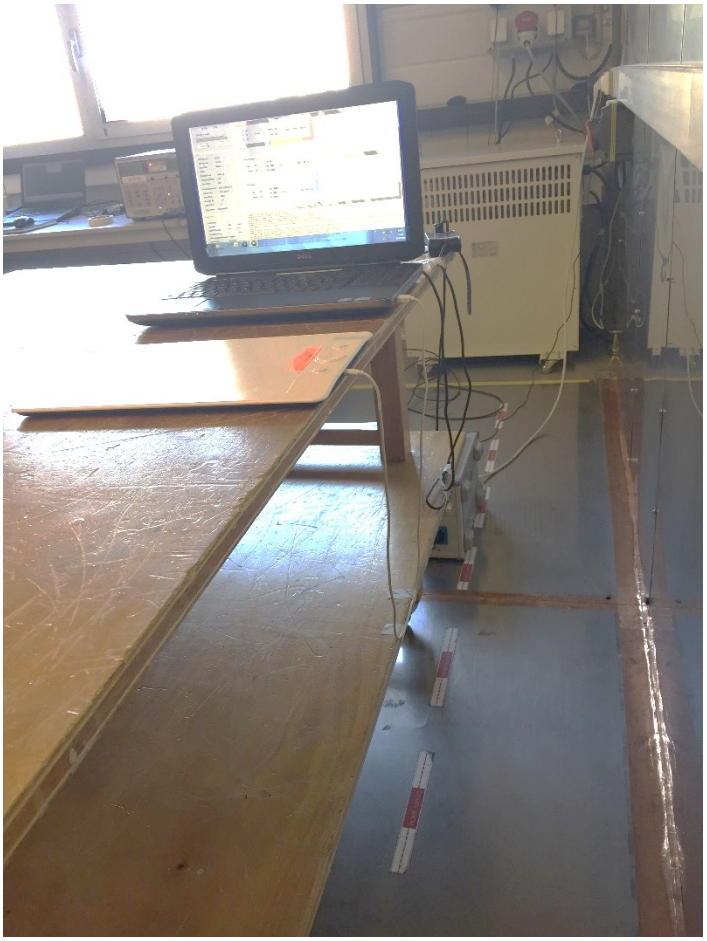
☐ 10cm above the ground on isolating support (Floor standing equipment)

The distance between the EUT and the LISN is 80cm. The EUT is 40cm away for the vertical ground plane.

The EUT is powered through laptop powered by 120Vac/60Hz and 240Vac/50Hz.

The EUT is powered through a LISN (measure). Auxiliaries are powered by another LISN.





Test setup

3.3. TEST METHOD

The product has been tested according to ANSI C63.10, ANSI C63.4 and FCC Part 15 subpart B and C. The product has been tested with a voltage sets (see the table voltage in §2.2) and compared to the FCC Part 15 limits. Measurement bandwidth was 9kHz from 150kHz to 30MHz. This was followed by a Quasi-Peak, i.e. CISPR measurement for any strong signal. If the average limit is met when using a Quasi-Peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary. The LISN (measure) is 50Ω / 50µH. The Peak data are shown on plots in annex 1. Quasi-Peak and Average measurements are detailed in a table with frequencies and levels measured. Interconnecting cables and equipment's were moved to position that maximized emission. A summary of the worst case emissions found in all test configurations and modes is shown on the following page.
Measurements are performed on the phase (L1) and neutral (N) of power line voltage (for example). Graphs are obtained in PEAK detection. Measures are also performed in Quasi-Peak and Average for any strong signal.

3.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Cable + self	-	-	A5329578	10/18	10/19
EMC comb generator	LCIE SUD EST	-	A3169098	-	-
LISN	RHODE & SCHWARZ	ENV216	C2320291	02/19	02/20
Receiver 9kHz - 30MHz	ROHDE & SCHWARZ	ESHS10	A2642028	11/18	11/19
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20
Transient limiter	RHODE & SCHWARZ	ESH3-Z2	A7122204	02/19	02/20

3.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

3.6. TEST RESULTS

USB tests Results (Laptop measurement):
Measurements are performed on the phase (L1) and neutral (N) of the power line.
Results: (PEAK detection)

Graph identifier		Line	Comments	
Emc#	1	Phase	120VAC/60Hz	See Annex
Emc#	2	Neutral	120VAC/60Hz	See Annex
Emc#	3	Phase	240VAC/50Hz	See Annex
Emc#	4	Neutral	240VAC/50Hz	See Annex

3.7. CONCLUSION

The sample of the equipment TB1E1, Sn: 200228, tested in the configuration presented in this test report **satisfies** to requirements of class B limits of the standard FCC Part 15 Subpart B and C, for conducted emissions.

4. RADIATED EMISSION DATA (15.209)

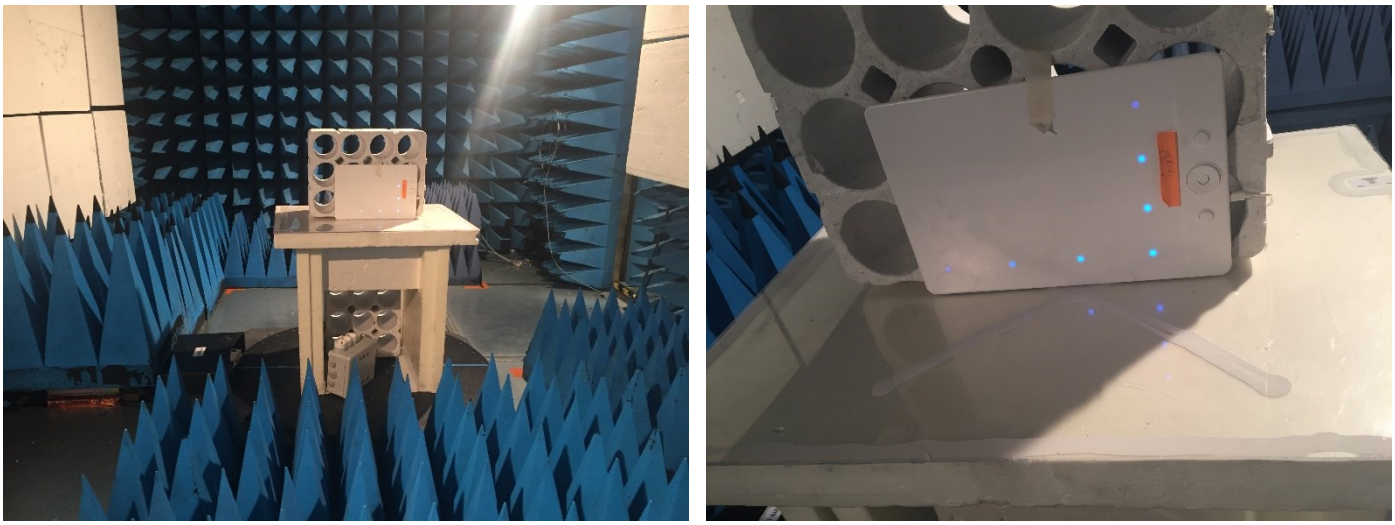
4.1. ENVIRONMENTAL CONDITIONS

Date of test	:	July 25, 2019	:
Test performed by	:	Majid Mourzagh	:
Atmospheric pressure (hPa)	:	987	
Relative humidity (%)	:	39	
Ambient temperature (°C)	:	25	

4.2. TEST SETUP

The installation of EUT is identical for pre-characterization measures in a 3 meters semi- anechoic chamber and for measures on the 10 meters Open site.
The EUT and auxiliaries are set:
☑ 80cm above the ground on the non-conducting table (Table-top equipment) - Below 1GHz
☑ 150cm above the ground on the non-conducting table (Table-top equipment) - Above 1GHz
☐ 10cm above the ground on isolating support (Floor standing equipment)
The EUT is powered by V_{nom}.

Axis XY



Axis Z

Test setup in anechoic chamber

Axis Z

Axis XY

Test setup on OATS

4.3. TEST METHOD

The product has been tested according to ANSI C63.10, ANSI C63.4, FCC Part 15 Subpart B and C.
Pre-characterisation measurement: (9kHz – 3.6GHz)
A pre-scan of all the setup has been performed in a 3 meters semi-anechoic chamber for frequency from 30MHz to 3.6GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test for maximized the emission measurement. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration.

Characterization on 10 meters open site from 9kHz to 1GHz:
Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC. The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC Part 15 Subpart B and C limits. Measurement bandwidth was 9kHz below 30MHz and 120kHz from 30 MHz to 1GHz. Test is performed in horizontal (H) and vertical (V) polarization, the loop antenna was rotated during the test for maximized the emission measurement. The height antenna is varied from 1m to 4m. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown.
Frequency list has been created with anechoic chamber pre-scan results.

Characterization on 3 meters full anechoic chamber from 1GHz to 3.6GHz:
The product has been tested at a distance of **3 meters** from the antenna and compared to the FCC Part 15 Subpart B and C limits. Measurement bandwidth was 1MHz from 1GHz to 3.6GHz. Test is performed in horizontal (H) and vertical (V) polarization. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on all axis of EUT used in normal configuration. A summary of the worst case emissions found in all test configurations and modes is shown.The height antenna is

☐ On mast, varied from 1m to 4m
☑ Fixed and centered on the EUT (EUT smaller than the beamwidth of the measurement antenna, ANSI C63.10 §6.6.5)
Frequency list has been created with anechoic chamber pre-scan results.

4.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Amplifier 9kHz - 40GHz	LCIE SUD EST	_	A7102082	10/18	10/19
Antenna Bi-Log	CHASE	UPA6192	C2040221	01/18	01/20
Emission Cable C3	-	6GHz	A5329069	11/18	11/19
Emission Cable C3	-	6GHz	A5329637	02/19	02/20
Semi-Anechoic chamber #3	SIEPEL	-	D3044017	03/17	03/20
Radiated emission comb generator	BARDET	-	A3169050	-	-
Spectrum analyzer	ROHDE & SCHWARZ	FSV 30	A4060051	03/18	03/20
BAT EMC	NEXIO	v3.17.0.10	L1000115	-	-
Facteur OATS 30M-1GHz	LCIE	V3	L2000035	-	-
Thermo-hygrometer (C3)	OREGON	BAR206	B4204078	10/18	10/20
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20
Turntable chamber (Cage#3)	ETS Lingren	Model 2165	F2000371	-	-
Table C3	LCIE	-	F2000461	-	-
Turntable controller (Cage#3)	ETS Lingren	Model 2090	F2000444	-	-
Antenna Bi-log	CHASE	CBL6111A	C2040172	09/18	09/20
Emission Cable	SUCOFLEX	6GHz	A5329061	02/19	02/20
Cable (OATS)	-	1GHz	A5329623	03/19	03/20
OATS	-	-	F2000409	02/19	02/20
Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	A2642019	12/17	12/19
Turntable / Mast controller (OATS)	ETS Lindgren	Model 2066	F2000372	-	-
Antenna mast (OATS)	ETS Lindgren	2071-2	F2000392	-	-
Turntable (OATS)	ETS Lindgren	Model 2187	F2000403	-	-
Table C1/OATS	MATURO Gmbh	-	F2000437	-	-

4.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

4.6. TEST RESULTS

4.6.1. Pre-characterization at 3 meters [9kHz-30MHz]

See graph for 9kHz-30MHz band:

Graph identifier		Polarization	EUT position	Comments	
Emr#	1	0°/90°	Axis XY	/	See annex 1
Emr#	2	180°	Axis XY	/	See annex 1
Emr#	3	0°/90°	Axis Z	/	See annex 1
Emr#	4	180°	Axis Z	/	See annex 1

4.6.2. Pre-characterization at 3 meters [30MHz-1GHz]

See graphs for 30MHz-1GHz:

Graph identifier		Polarization	EUT position	Comments	
Emr#	5	Horizontal / Vertical	Axis XY	/	See annex 1
Emr#	6	Horizontal / Vertical	Axis Z	/	See annex 1

4.6.1. Pre-characterization at 3 meters [1GHz-3.6GHz]

See graphs for 1GHz-3.6GHz:

Graph identifier		Polarization	EUT position	Comments	
Emr#	7	Horizontal / Vertical	Axis XY	/	See annex 1
Emr#	8	Horizontal / Vertical	Axis Z	/	See annex 1

4.6.2. Characterization on 10 meters open site below 30 MHz

Worst case final data result:

Frequency list has been created with semi-anechoic chamber pre-scan results.
Measurements are performed using a QUASI-PEAK detection.

No	Frequency (MHz)	QPeak Limit (dBµV/m) @ 30m	Qpeak (dBµV/m) @ 30m	Margin (Mes-Lim) (dB)	Angle Table (deg)	Pol Ant.	Ht Ant. (cm)	Correc. Factor (dB)	Comments
1	**13.56**	**84**	**23.5**	**-60.5**	**0**	**90°**	**150**	**35.5**	**/**

Note: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@30m = M@10m-19.1dB)

Limits Sub clause §15.225

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
13.553-13.567	15 848 84 dBµV/m	30
13.410-13.553 13.567-13.710	334 50.5 dBµV/m	30
13.110-13.410 13.710-14.010	106 40.5 dBµV/m	30

See following chapter of this test report for band edge measurements.

4.6.3. Characterization on 10 meters open site from 30MHz to 1GHz

Worst case final data result:

Frequency list has been created with semi-anechoic chamber pre-scan results.
Measurements are performed using a QUASI-PEAK detection.

Test Frequency (MHz)	Meter Reading dB(µV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Transducer Factor (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
60.000	20.5	QP	V	45	100	8.1	28.6	40.0	**-11.4**
72.000	19.0	QP	V	0	100	8.6	27.6	40.0	**-12.4**
300.000	18.3	QP	V	240	120	16.6	34.9	46.0	**-11.1**
488.000	15.5	QP	V	0	110	21.8	37.3	46.0	**-8.7**

Note: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@3m = M@10m+10.5dB)

4.6.1. Characterization on 3meters anechoic chamber from 1GHz to 3.6GHz

Worst case final data result:

The frequency list is created from the results obtained during the pre-characterization in anechoic chamber. Measurements are performed using a PEAK and AVERAGE detection.

Test Frequency (MHz)	Meter Reading dB(µV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Transducer Factor (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
3325.70	72.5	Av	V	0	150	-28.7	43.8	54.0	**-10.2**
3499.90	71.7	Av	V	0	150	-28.2	43.5	54.0	**-10.5**
3527.72	71.9	Av	V	0	150	-28.1	43.8	54.0	**-10.2**
3350.14	72.0	Av	V	0	150	-28.7	43.3	54.0	**-10.7**

Test Frequency (MHz)	Meter Reading dB(µV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Transducer Factor (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
3325.70	84.0	Pk	V	0	150	-28.7	55.3	74.0	**-18.7**
3499.90	83.2	Pk	V	0	150	-28.2	55.0	74.0	**-19.0**
3527.72	82.8	Pk	V	0	150	-28.1	54.7	74.0	**-19.3**
3350.14	84.0	Pk	V	0	150	-28.7	55.3	74.0	**-18.7**

4.7. CONCLUSION

The sample of the equipment TB1E1, Sn: 200228, tested in the configuration presented in this test report **satisfies** to requirements of class B limits of the standard FCC Part 15 Subpart B and C, for radiated emissions.

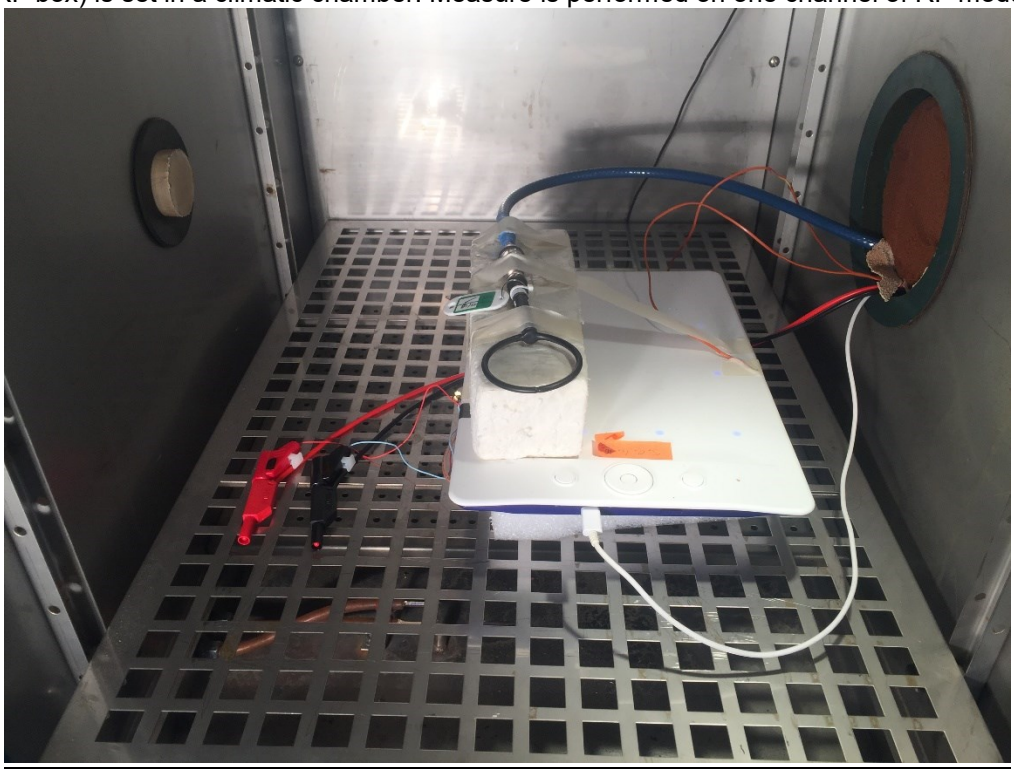
5. FUNDAMENTAL FREQUENCY TOLERANCE (15.225E)

5.1. ENVIRONMENTAL CONDITIONS

Date of test	:	July 30, 2019
Test performed by	:	Majid Mourzagh
Atmospheric pressure (hPa)	:	988
Relative humidity (%)	:	38
Ambient temperature (°C)	:	23

5.2. TEST SETUP

Frequency of carrier: 13.56 MHz
Upper limit: 13.561356 MHz
Lower limit: 13.558644 MHz
The equipment (RF box) is set in a climatic chamber. Measure is performed on one channel of RF module.



Test setup

5.3. TEST METHOD

The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency when the temperature is varied from -20°C to +50°C at the nominal power voltage and the primary power voltage is varied from 85% to 115% of the rated supply voltage at 20°C.

5.4. TEST EQUIPMENT LIST

DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Antenna Loop	ELECTRO-METRICS	EM-6993	C2040215	06/19	06/21
Cable SMA	-	18GHz	A5329863	11/18	11/19
Cable SMA	-	18GHz	A5329864	11/18	11/19
Climatic chamber	BIA CLIMATIC	CL 6-25	D1022117	03/18	03/20
Spectrum Analyzer 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020	06/18	06/20
Thermometer (radio)	FLUKE	52 II	B4043150	08/18	08/19
Thermocouple K (radio)	FLUKE	Type K	B4045004	08/18	08/19
Thermocouple K (radio)	FLUKE	Type K	B4045005	08/18	08/19
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20

5.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

5.6. TEST RESULTS

Temperature Voltage	-30°C	20°C	+55°C
Mains voltage: 3.7Vdc Frequency Drift (MHz) Carrier level (dBc)	- 0.000253 + 0.85	**13.560317** **-3.000000**	- 0.000310 + 0.27
Mains voltage: 3.1Vdc Frequency Drift (MHz) Carrier level (dBc)	- 0.000268 + 0.38	- 0.000207 + 0.36	- 0.000265 - 0.05
Mains voltage: 4.3Vdc Frequency Drift (MHz) Carrier level (dBc)	- 0.000268 + 0.38	- 0.000204 + 0.32	- 0.000262 - 0.14

Frequency drift measured is -310Hz when the temperature is varied from -30°C to +55°C and voltage is varied.

5.1. CONCLUSION

The sample of the equipment TB1E1, Sn: 200230, tested in the configuration presented in this test report **satisfies** to requirements of the standard FCC Part 15 Subpart B and C, for fundamental frequency tolerance.

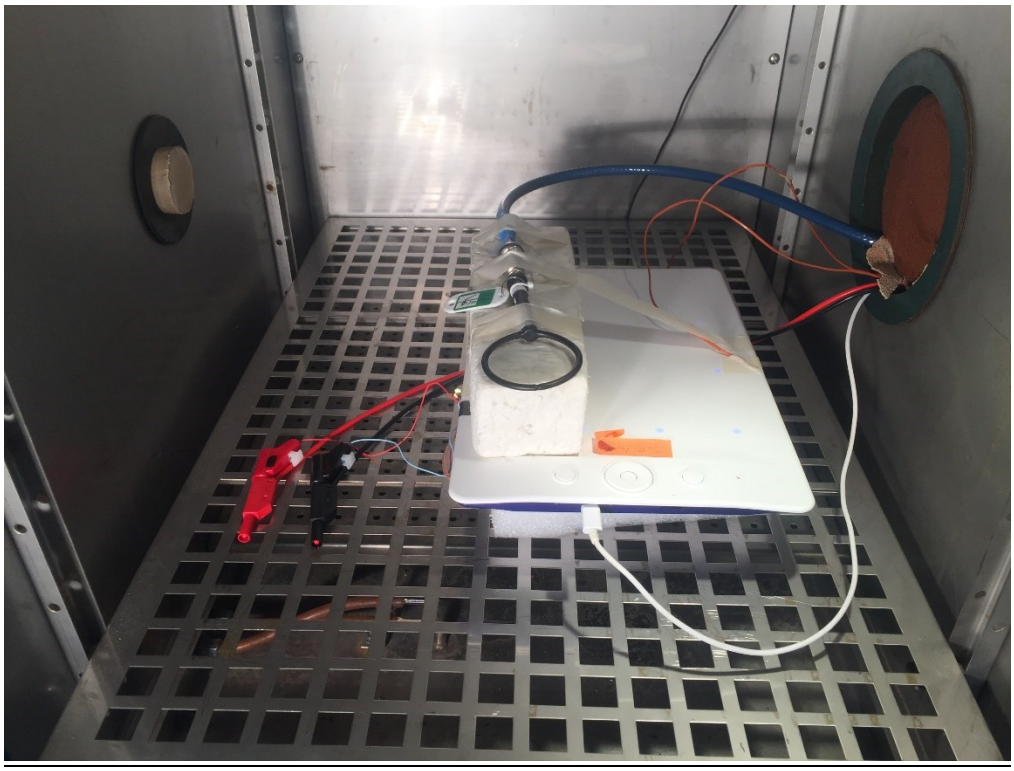
6. BAND-EDGE COMPLIANCE §15.209

6.1. ENVIRONMENTAL CONDITIONS

Date of test	:	July 30, 2019
Test performed by	:	Majid Mourzagh
Atmospheric pressure (hPa)	:	988
Relative humidity (%)	:	38
Ambient temperature (°C)	:	23

6.2. TEST SETUP

For measurement, the power level calibration of the spectrum analyzer is related to the field strength measured in chapter radiated emission data.



Test setup

6.3. TEST METHOD

Frequency band 13.110-14.010MHz

Following plots show radiated emission level in the frequency band 13.110-14.010MHz with a RBW of 9kHz and a quasi-peak detector. The graphs are obtained with a measuring receiver.

Frequency band 13.553-13.567MHz

Following plots show radiated emission level in the frequency band 13.55.-13.567MHz with a RBW of 1kHz. The graphs are obtained with a measuring receiver.

6.4. TEST EQUIPMENT LIST

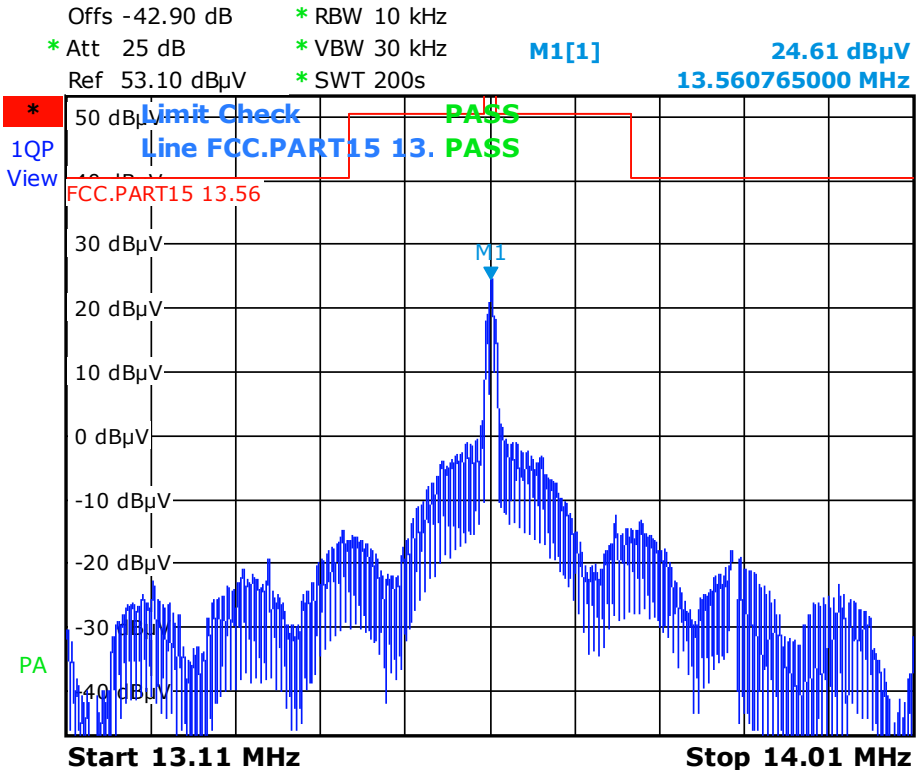
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Antenna Loop	ELECTRO-METRICS	EM-6993	C2040215	06/19	06/21
Cable SMA	-	18GHz	A5329863	11/18	11/19
Cable SMA	-	18GHz	A5329864	11/18	11/19
Climatic chamber	BIA CLIMATIC	CL 6-25	D1022117	03/18	03/20
Spectrum Analyzer 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020	06/18	06/20
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20

6.5. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

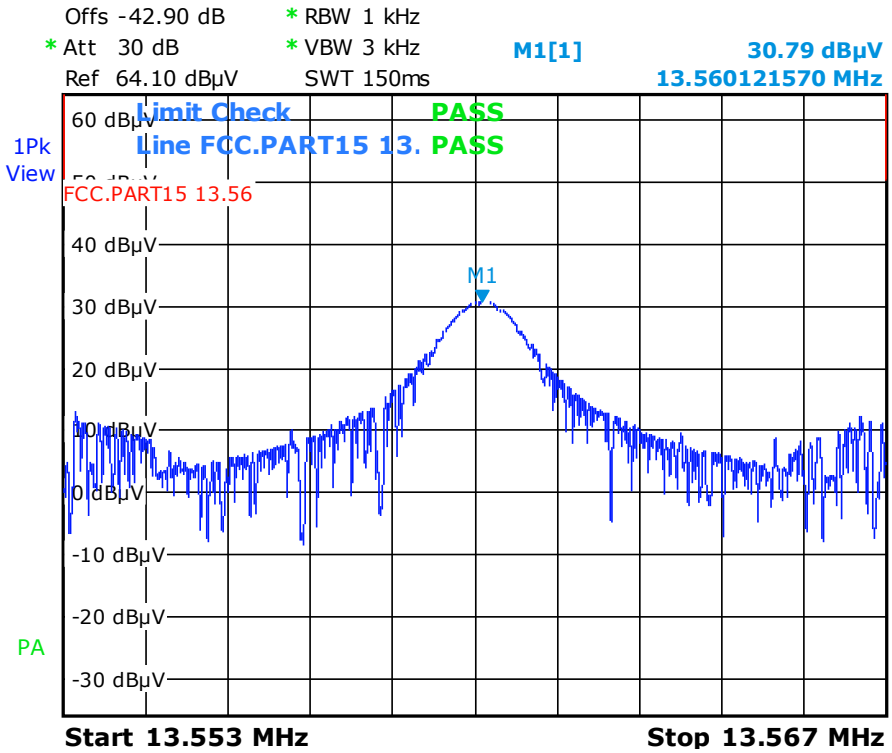
☑ None ☐ Divergence:

6.6. TEST RESULTS

Frequency band 13.110-14.010MHz



Frequency band 13.553-13.567MHz



6.7. CONCLUSION

The sample of the equipment TB1E1, Sn: 200230, tested in the configuration presented in this test report **satisfies** to requirements of the standard FCC Part 15 Subpart B and C, for band-edge compliance.

7. OCCUPIED BANDWIDTH

7.1. ENVIRONMENTAL CONDITIONS

Date of test : July 30, 2019
Test performed by : Majid Mourzagh
Atmospheric pressure (hPa) : 988
Relative humidity (%) : 38
Ambient temperature (°C) : 23

7.2. TEST SETUP

☐ ***Conducted measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

☑ ***Radiated measurement:***
The EUT is turned ON and connected to measurement instrument; the center frequency of the spectrum analyzer is set to the fundamental frequency. The captured power is measured and recorded; the measurement is repeated until all frequencies required were complete.

Measurement Procedure:
1. RBW used in the range of 1% to 5% of the anticipated emission bandwidth
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = Max Hold.
5. Sweep = Auto couple.
6. Allow the trace to stabilize.
7. OBW 99% function of spectrum analyzer used

7.3. TEST EQUIPMENT LIST

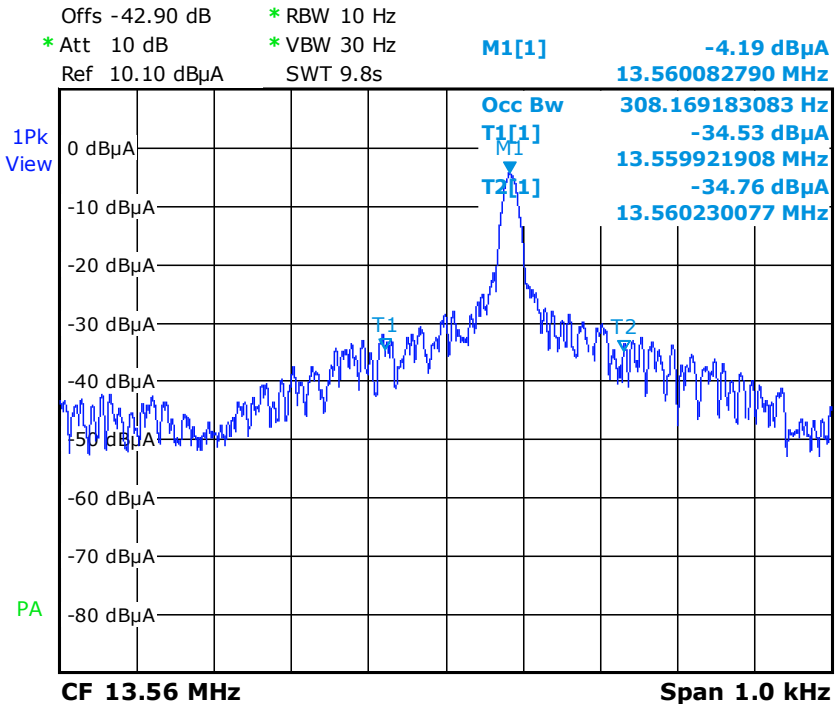
DESCRIPTION	MANUFACTURER	MODEL	N° LCIE	Cal_Date	Cal_Due
Antenna Loop	ELECTRO-METRICS	EM-6993	C2040215	06/19	06/21
Cable SMA	-	18GHz	A5329863	11/18	11/19
Cable SMA	-	18GHz	A5329864	11/18	11/19
Climatic chamber	BIA CLIMATIC	CL 6-25	D1022117	03/18	03/20
Spectrum Analyzer 9kHz - 6GHz	ROHDE & SCHWARZ	FSL6	A2642020	06/18	06/20
Thermo-hygrometer (PM1/2/3)	KIMO	HQ 210	B4206022	08/18	08/20

7.4. DIVERGENCE, ADDITION OR SUPPRESSION ON THE TEST SPECIFICATION

☑ None ☐ Divergence:

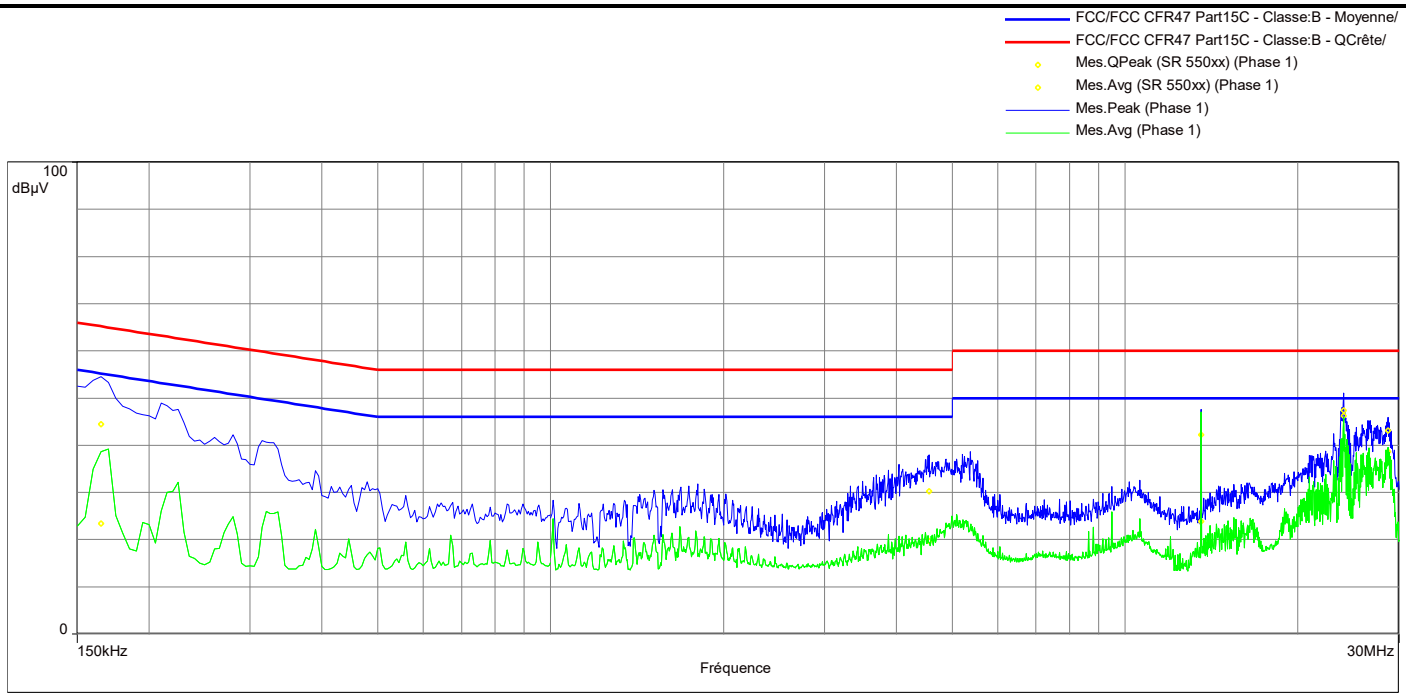
7.5. TEST SEQUENCE AND RESULTS

Channel	Channel Frequency (MHz)	99% Occupied Bandwidth (Hz)
Nom	13.56	**308.169**



8. ANNEX 1 (GRAPHS)

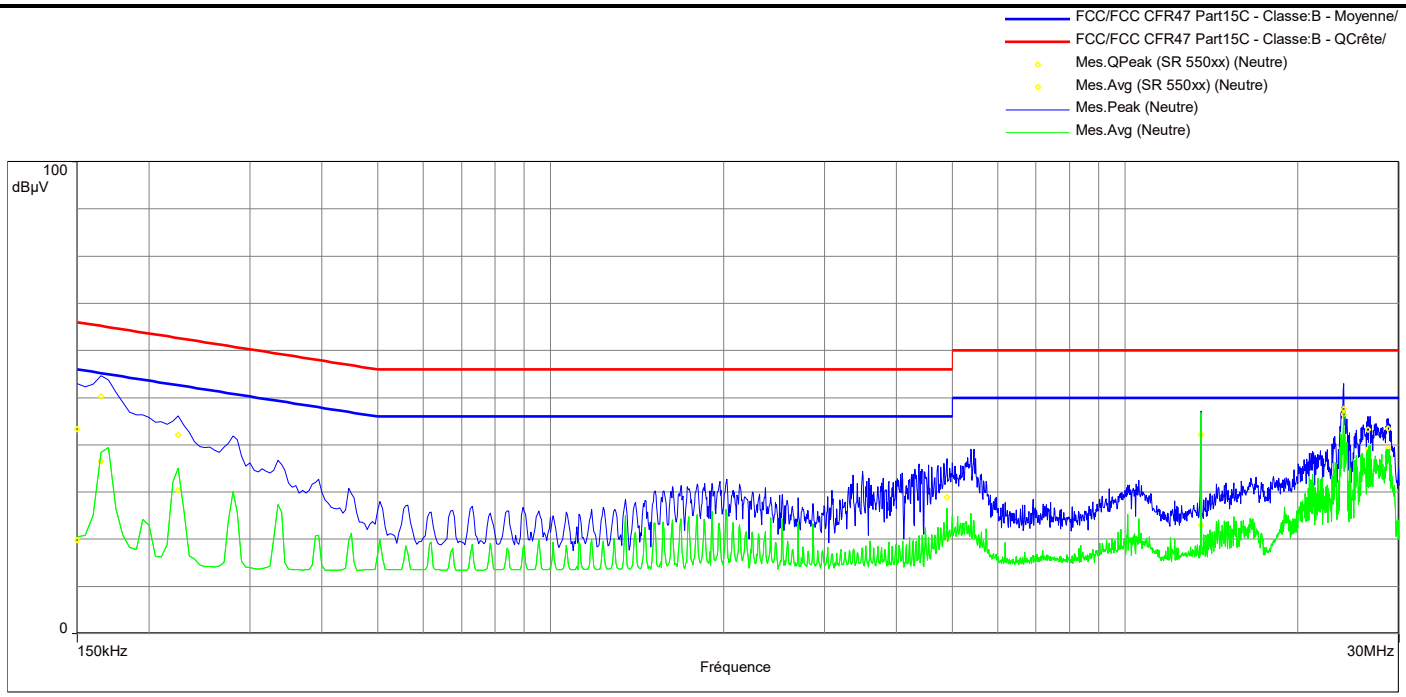
CONDUCTED EMISSIONS			
Graph name:	Emc#1	**Test configuration:**	
Limit:	FCC CFR47 Part15C	L1-120V/60Hz	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	120VAC / 60Hz	**RBW :**	10kHz
Line:	Phase	**VBW :**	30kHz



Spurious emissions

Frequency (MHz)	Mes.QPeak (dBµV)	LimQP (dBµV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBµV)	LimAvg (dBµV)	Mes.Avg-LimAvg (dB)	Line	Correction (dB)
0.165	44.5	65.2	-20.7	23.4	55.2	-31.8	Phase 1	19.4
4.560	30.2	56.0	-25.8	19.8	46.0	-26.2	Phase 1	19.8
13.560	42.3	60.0	-17.7	23.9	50.0	-26.1	Phase 1	20.5
24.000	47.4	60.0	-12.6	46.3	50.0	-3.7	Phase 1	21.2
28.690	43.1	60.0	-16.9	38.7	50.0	-11.3	Phase 1	21.4

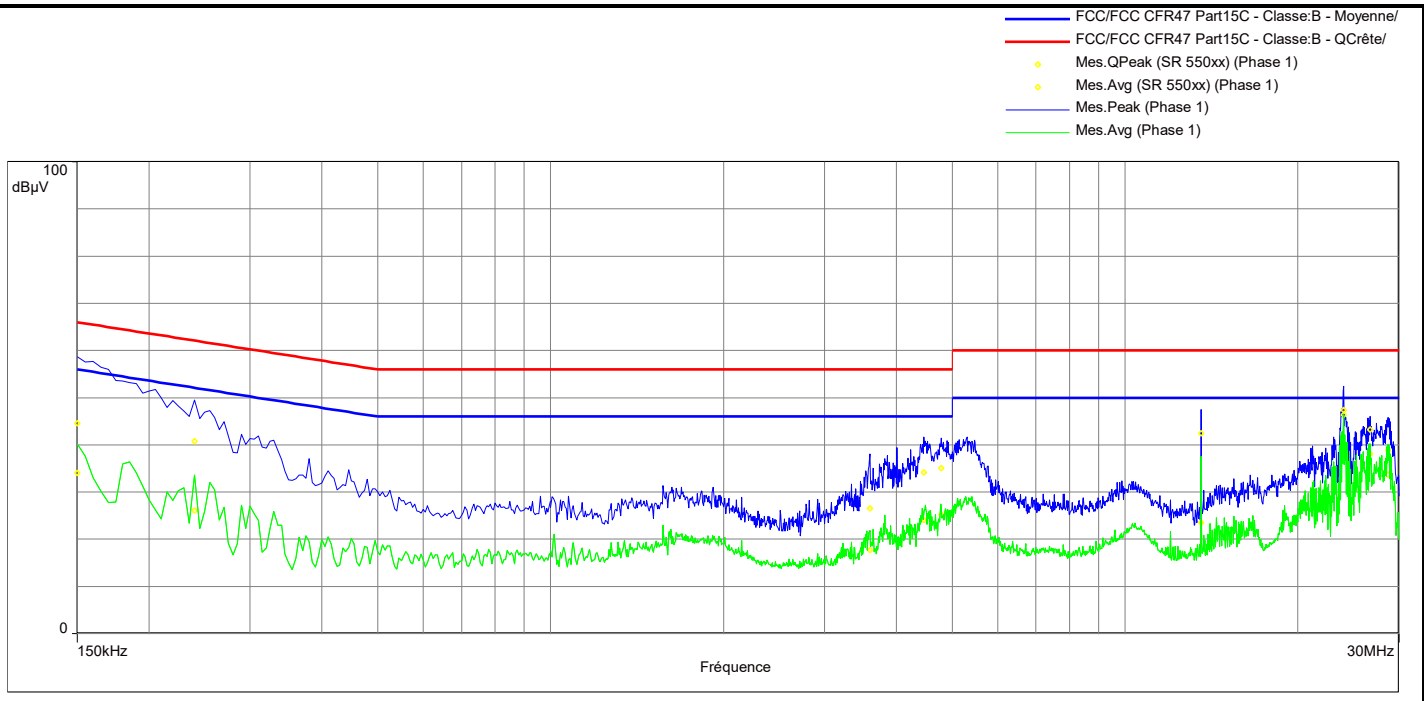
CONDUCTED EMISSIONS			
Graph name:	Emc#2	**Test configuration:**	
Limit:	FCC CFR47 Part15C	Neutral-120V/60Hz	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	120VAC / 60Hz	**RBW :**	10kHz
Line:	Neutral	**VBW :**	30kHz



Spurious emissions

Frequency (MHz)	Mes.QPeak (dBµV)	LimQP (dBµV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBµV)	LimAvg (dBµV)	Mes.Avg-LimAvg (dB)	Line	Correction (dB)
0.150	43.3	66.0	-22.7	19.8	56.0	-36.2	Neutre	19.4
0.165	50.3	65.2	-14.9	36.6	55.2	-18.6	Neutre	19.4
0.225	42.1	62.6	-20.5	30.3	52.6	-22.3	Neutre	19.5
4.895	28.9	56.0	-27.1	20.2	46.0	-25.8	Neutre	19.8
13.560	42.1	60.0	-17.9	23.0	50.0	-27.0	Neutre	20.5
24.000	47.6	60.0	-12.4	46.4	50.0	-3.6	Neutre	21.2
26.465	43.2	60.0	-16.8	39.1	50.0	-10.9	Neutre	21.3
28.690	43.4	60.0	-16.6	39.2	50.0	-10.8	Neutre	21.4

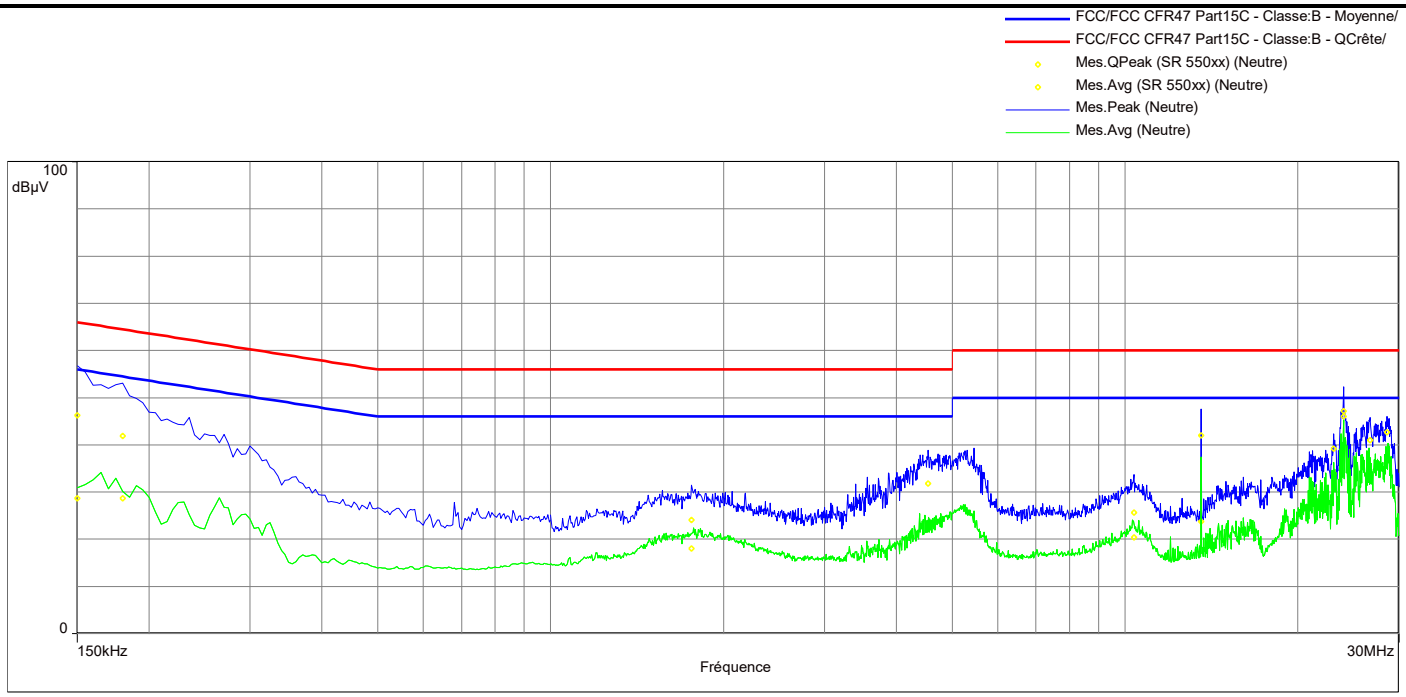
CONDUCTED EMISSIONS			
Graph name:	Emc#3	**Test configuration:**	
Limit:	FCC CFR47 Part15C	L1-240V/50Hz	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	240VAC / 50Hz	**RBW :**	10kHz
Line:	Phase	**VBW :**	30kHz



Spurious emissions

Frequency (MHz)	Mes.QPeak (dBµV)	LimQP (dBµV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBµV)	LimAvg (dBµV)	Mes.Avg-LimAvg (dB)	Line	Correction (dB)
0.150	44.6	66.0	-21.4	34.0	56.0	-22.0	Phase 1	19.4
0.240	40.8	62.1	-21.3	26.1	52.1	-26.0	Phase 1	19.5
3.600	26.6	56.0	-29.4	17.7	46.0	-28.3	Phase 1	19.7
4.460	34.2	56.0	-21.8	24.1	46.0	-21.9	Phase 1	19.8
4.785	35.1	56.0	-20.9	25.2	46.0	-20.8	Phase 1	19.8
13.560	42.4	60.0	-17.6	23.6	50.0	-26.4	Phase 1	20.5
24.000	47.4	60.0	-12.6	46.3	50.0	-3.7	Phase 1	21.2
26.695	43.2	60.0	-16.8	38.1	50.0	-11.9	Phase 1	21.3
28.685	38.8	60.0	-21.2	33.8	50.0	-16.2	Phase 1	21.4

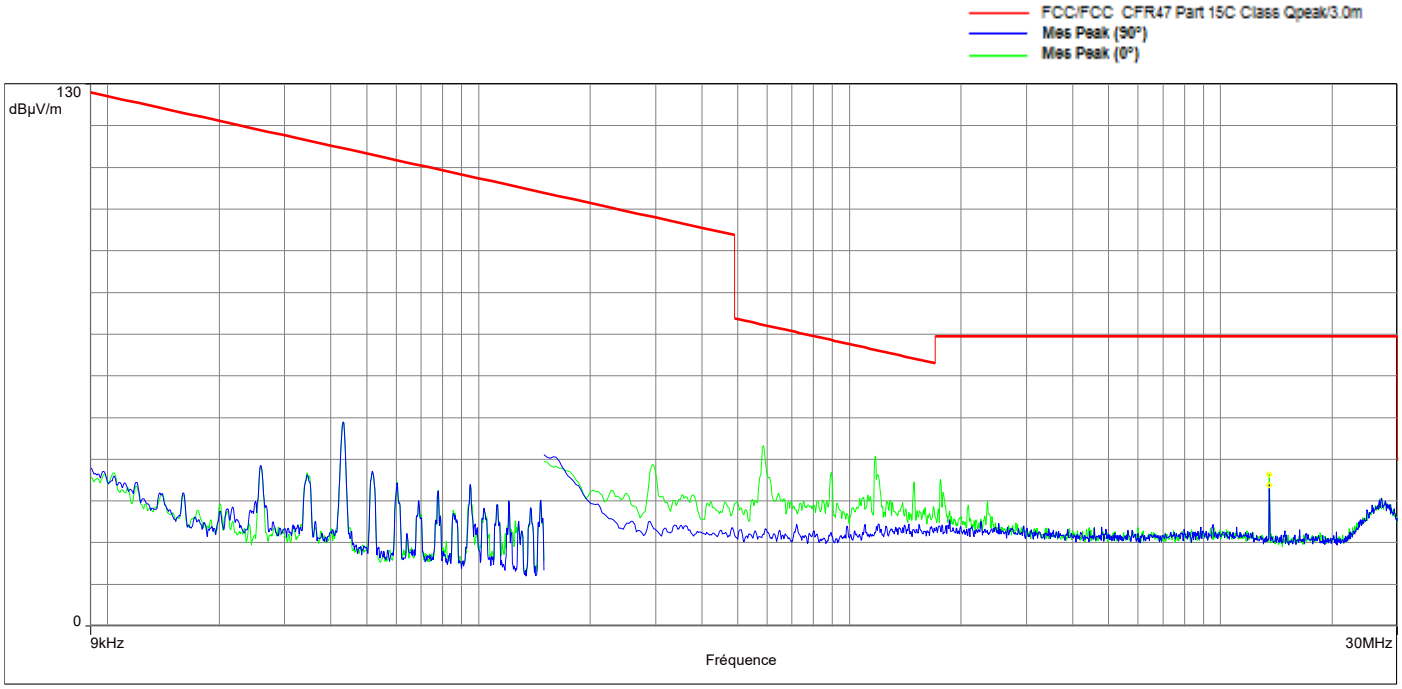
CONDUCTED EMISSIONS			
Graph name:	Emc#4	**Test configuration:**	
Limit:	FCC CFR47 Part15C	Neutral-240V/50Hz	
Class:	B		
Frequency range: [150kHz - 30MHz]			
Voltage / Frequency:	240VAC / 50Hz	**RBW :**	10kHz
Line:	Neutral	**VBW :**	30kHz



Spurious emissions

Frequency (MHz)	Mes.QPeak (dBµV)	LimQP (dBµV)	Mes.QPeak-LimQP (dB)	Mes.Avg (dBµV)	LimAvg (dBµV)	Mes.Avg-LimAvg (dB)	Line	Correction (dB)
0.150	46.3	66.0	-19.7	28.7	56.0	-27.3	Neutre	19.4
0.180	41.9	64.5	-22.5	28.7	54.5	-25.8	Neutre	19.5
1.760	24.1	56.0	-31.9	18.1	46.0	-27.9	Neutre	19.6
4.545	31.8	56.0	-24.2	22.2	46.0	-23.8	Neutre	19.8
10.360	25.7	60.0	-34.3	20.4	50.0	-29.6	Neutre	20.3
13.560	42.0	60.0	-18.0	23.7	50.0	-26.3	Neutre	20.5
23.060	39.3	60.0	-20.7	33.9	50.0	-16.1	Neutre	21.1
24.000	47.2	60.0	-12.8	46.1	50.0	-3.9	Neutre	21.2
26.700	41.0	60.0	-19.0	33.5	50.0	-16.5	Neutre	21.3
28.575	42.7	60.0	-17.3	37.7	50.0	-12.3	Neutre	21.4

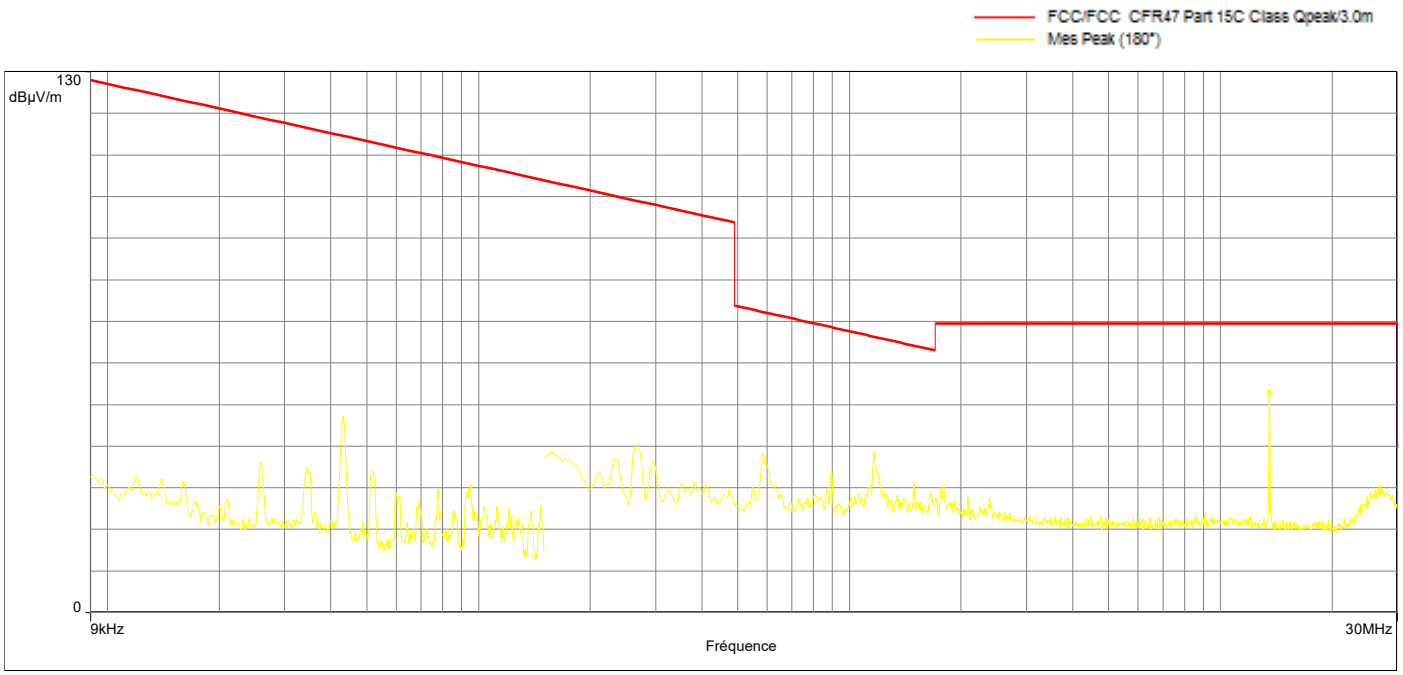
RADIATED EMISSIONS			
Graph name:	Emr#1	**Test configuration:**	
Limit:	FCC CFR47 Part15C	Pre-mesure - (0°/90°) - Axis XY	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:	0°/90°	**RBW :**	300Hz / 10kHz
Azimuth:	0° - 360°	**VBW :**	1kHz / 30kHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarization
13.559	33.8	90°
13.559	36.4	0°

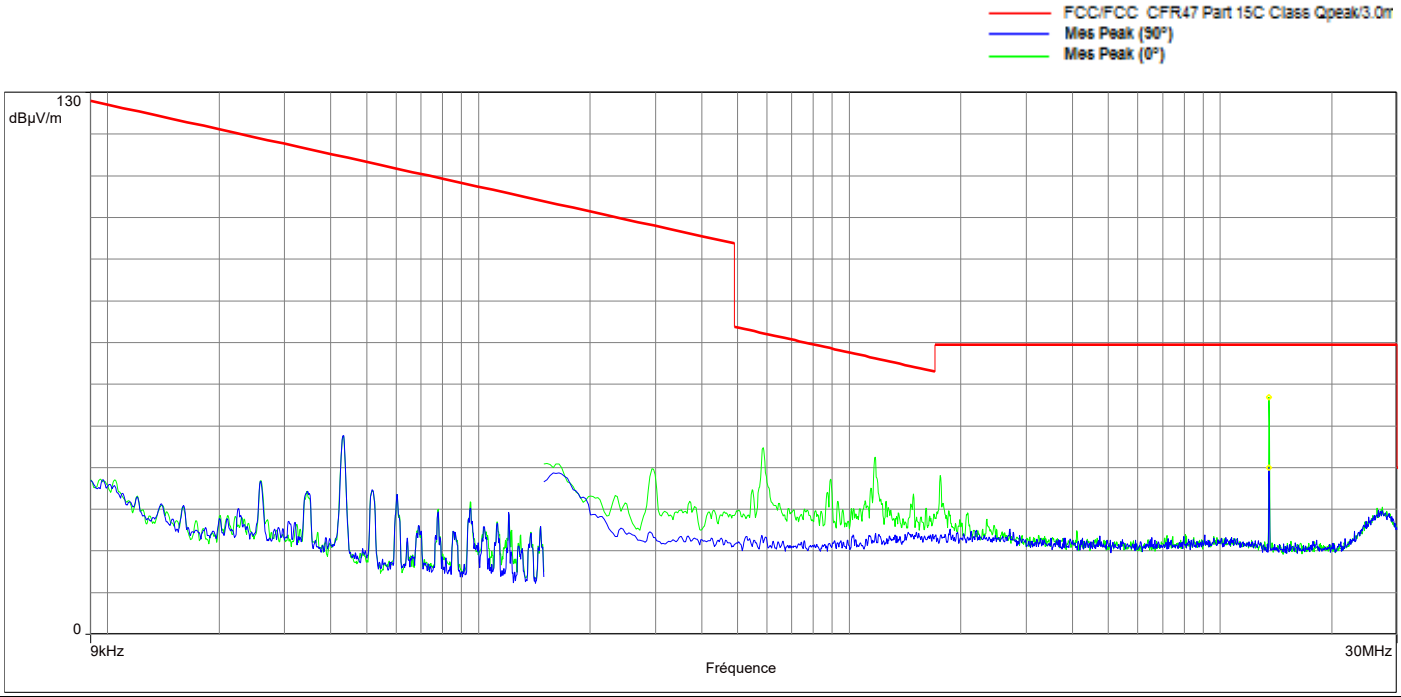
RADIATED EMISSIONS			
Graph name:	Emr#2	**Test configuration:**	
Limit:	FCC CFR47 Part15C	Pre-mesure - (180°) - Axis XY	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:	180°	**RBW :**	300Hz / 10kHz
Azimuth:	0° - 360°	**VBW :**	1kHz / 30kHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarization
13.559	52.8	180°

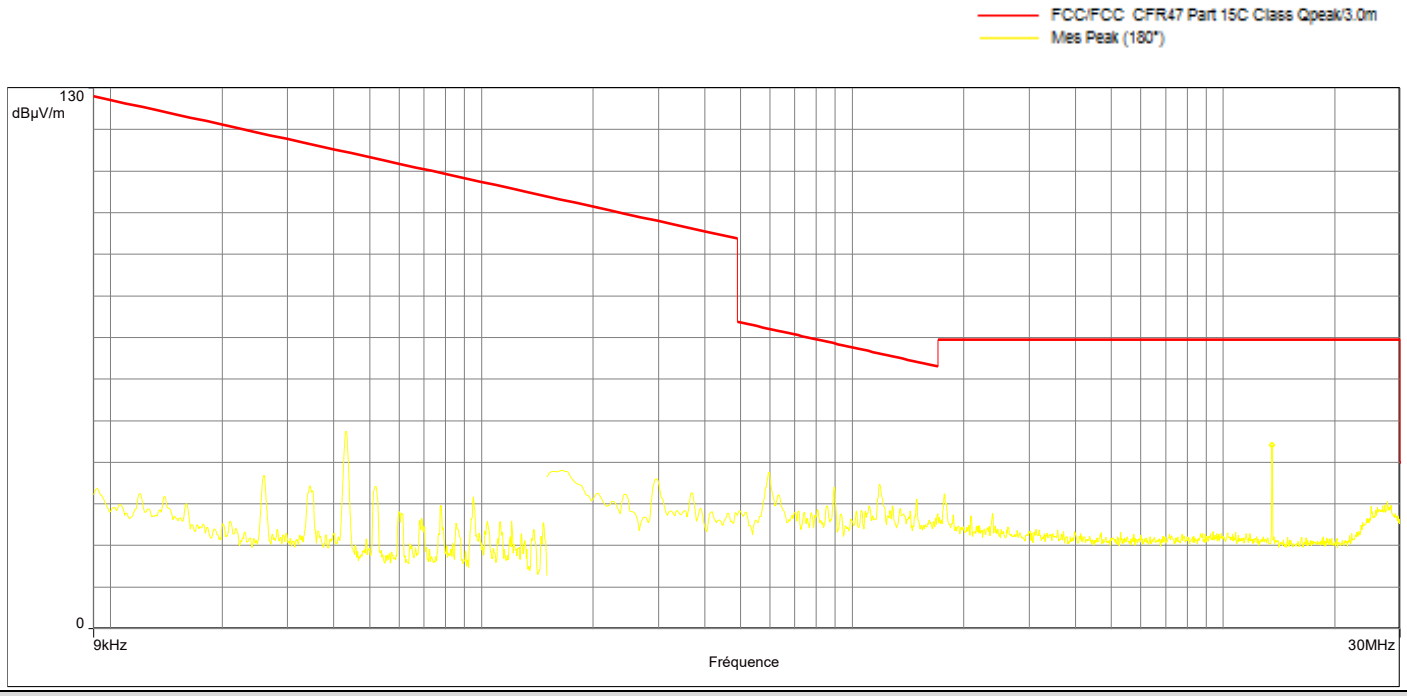
RADIATED EMISSIONS			
Graph name:	Emr#3	**Test configuration:**	
Limit:	FCC CFR47 Part15C	Pre-mesure - (0°/90°) - Axis Z	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:	0°/90°	**RBW :**	300Hz / 10kHz
Azimuth:	0° - 360°	**VBW :**	1kHz / 30kHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarization
13.559	40.0	90°
13.559	56.9	0°

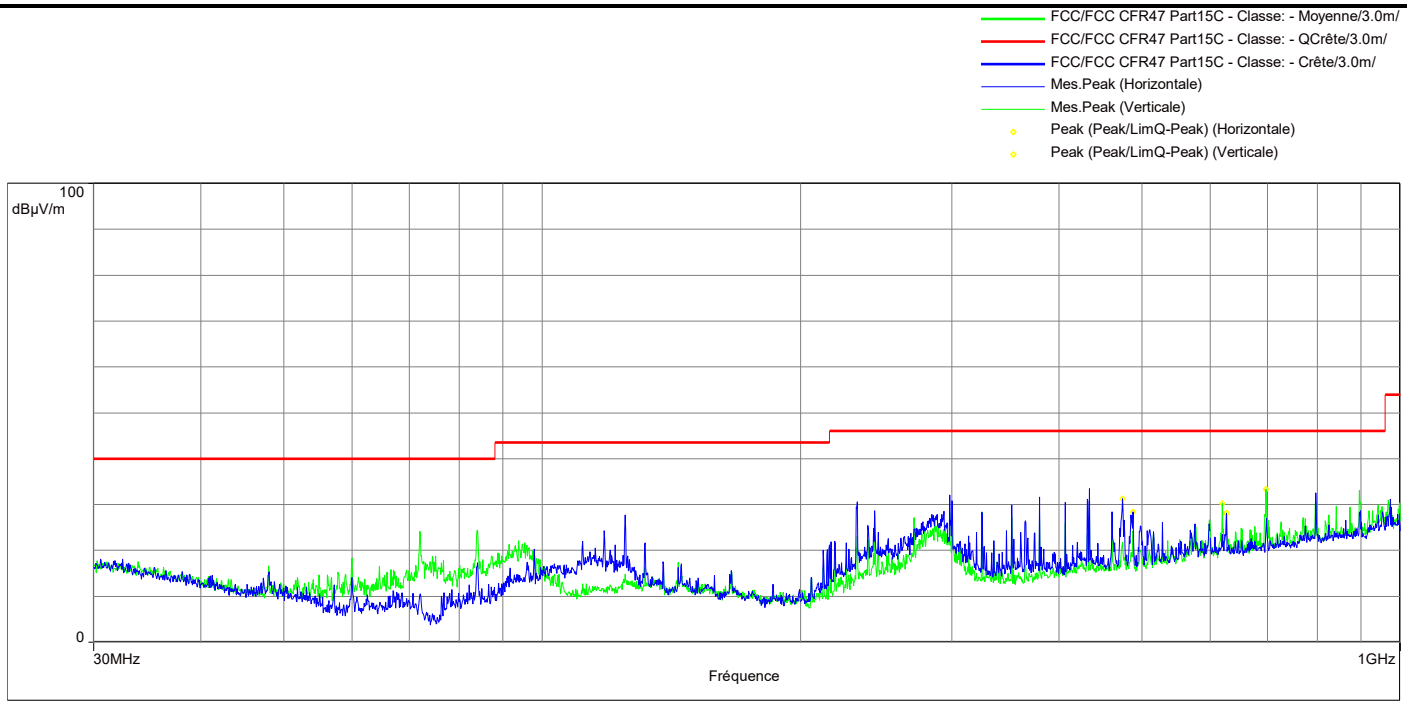
RADIATED EMISSIONS			
Graph name:	Emr#4	**Test configuration:**	
Limit:	FCC CFR47 Part15C	Pre-mesure - (180°) - Axis Z	
Class:			
Frequency range: [9kHz - 30MHz]			
Antenna polarization:	180°l	**RBW :**	300Hz / 10kHz
Azimuth:	0° - 360°	**VBW :**	1kHz / 30kHz



Spurious emissions

Frequency (MHz)	Peak Level (dBµV/m)	Polarization
13.559	44.2	180°

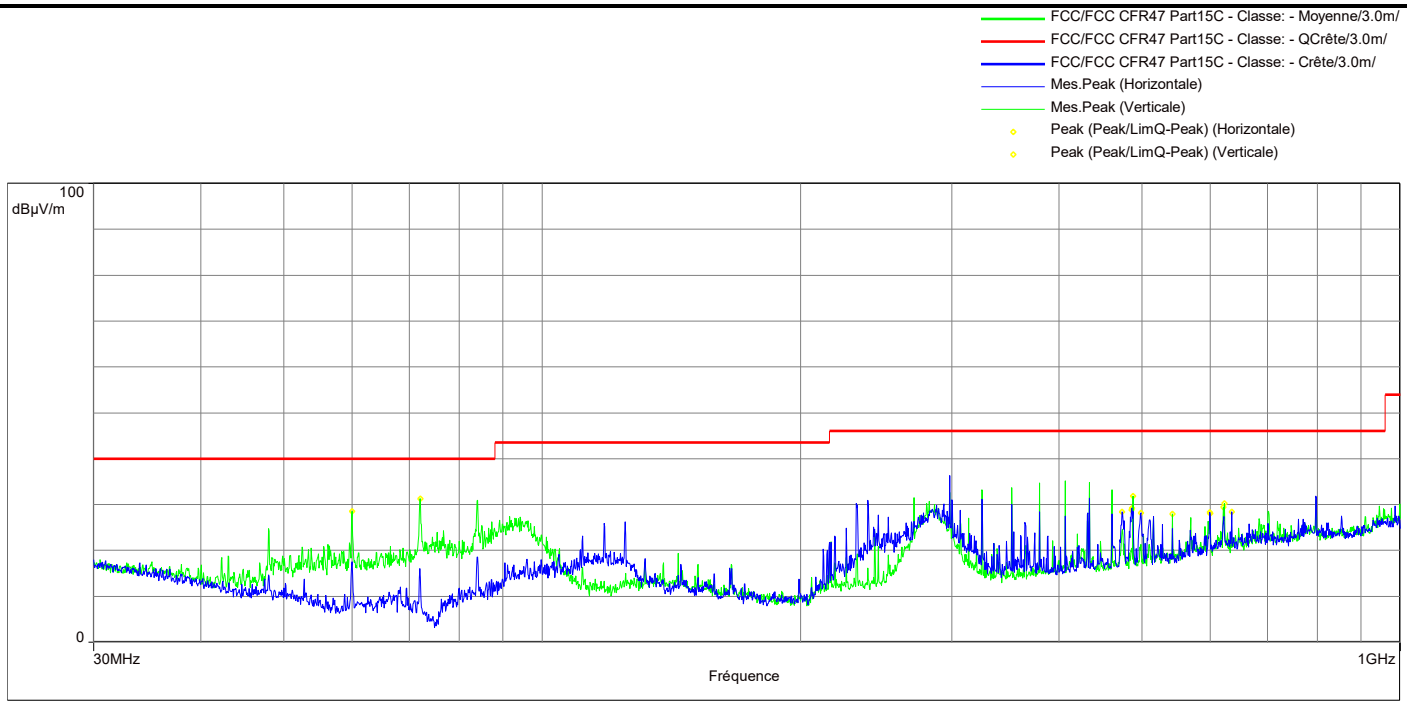
RADIATED EMISSIONS			
Graph name:	Emr#5	**Test configuration:**	
Limit:	FCC CFR47 Part15C	C3 - FSV(H+V)[0.03-1]GHz - Axis XY	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)	LimQP (dBµV/m)	Peak-LimQP (dB)	Polarization	Correction (dB)
474.200	31.2	46.0	-14.8	Horizontal	-15.5
488.200	28.4	46.0	-17.6	Horizontal	-15.2
627.440	28.1	46.0	-17.9	Horizontal	-12.8
620.360	30.2	46.0	-15.8	Vertical	-12.9
627.480	28.2	46.0	-17.8	Vertical	-12.8
697.280	33.4	46.0	-12.6	Vertical	-11.9

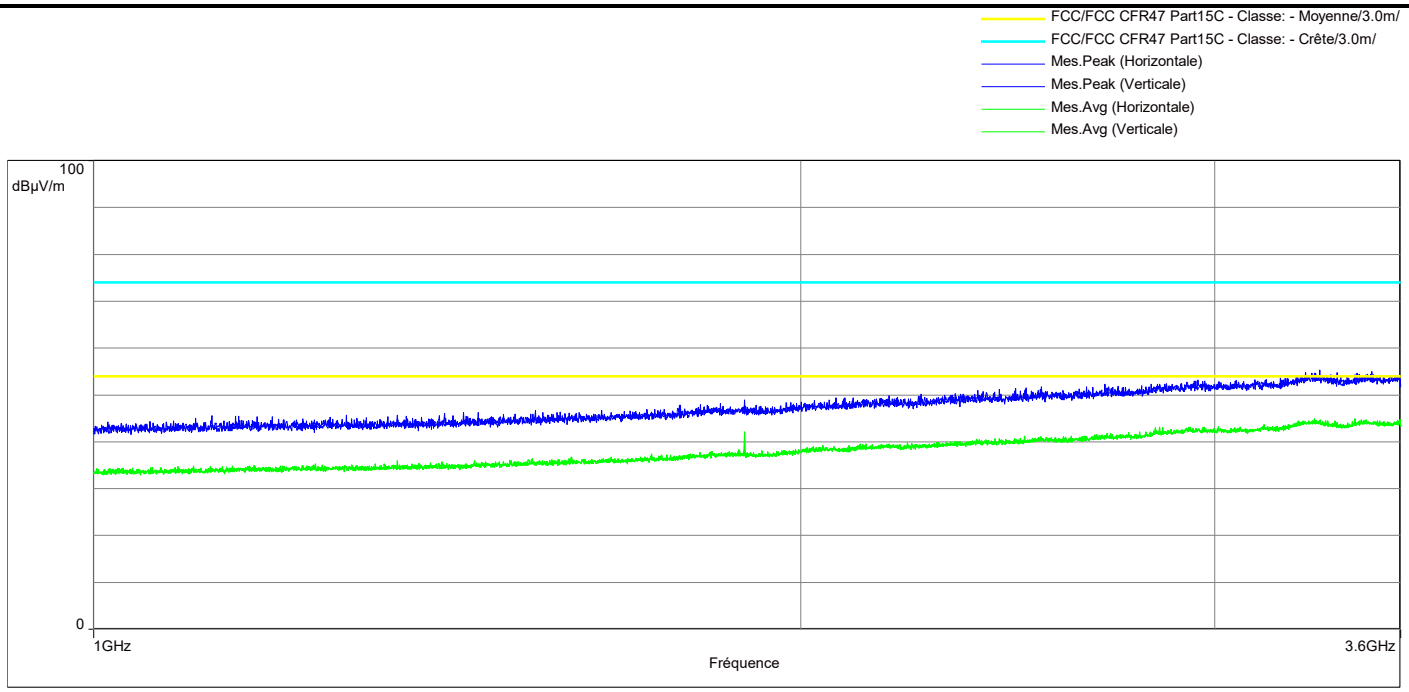
RADIATED EMISSIONS			
Graph name:	Emr#6	**Test configuration:**	
Limit:	FCC CFR47 Part15C	C3 - FSV(H+V)[0.03-1]GHz - Axis Z	
Class:			
Frequency range: [30MHz - 1GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	100kHz
Azimuth:	0° - 360°	**VBW :**	300kHz



Spurious emissions

Frequency (MHz)	Peak (dBµV/m)	LimQP (dBµV/m)	Peak-LimQP (dB)	Polarization	Correction (dB)
473.720	28.4	46.0	-17.6	Horizontal	-15.5
485.760	28.9	46.0	-17.1	Horizontal	-15.3
486.360	29.3	46.0	-16.7	Horizontal	-15.3
498.280	28.2	46.0	-17.8	Horizontal	-15.0
599.320	28.3	46.0	-17.7	Horizontal	-13.2
600.000	28.1	46.0	-17.9	Horizontal	-13.2
636.120	28.5	46.0	-17.5	Horizontal	-12.7
488.200	31.9	46.0	-14.1	Vertical	-15.2
542.440	28.0	46.0	-18.0	Vertical	-14.2
621.680	29.5	46.0	-16.5	Vertical	-12.9
623.400	30.3	46.0	-15.7	Vertical	-12.9
60.022	28.6	40.0	-11.4	Vertical	-25.3
72.041	31.34	40.00	-8.66	Vertical	-26.20

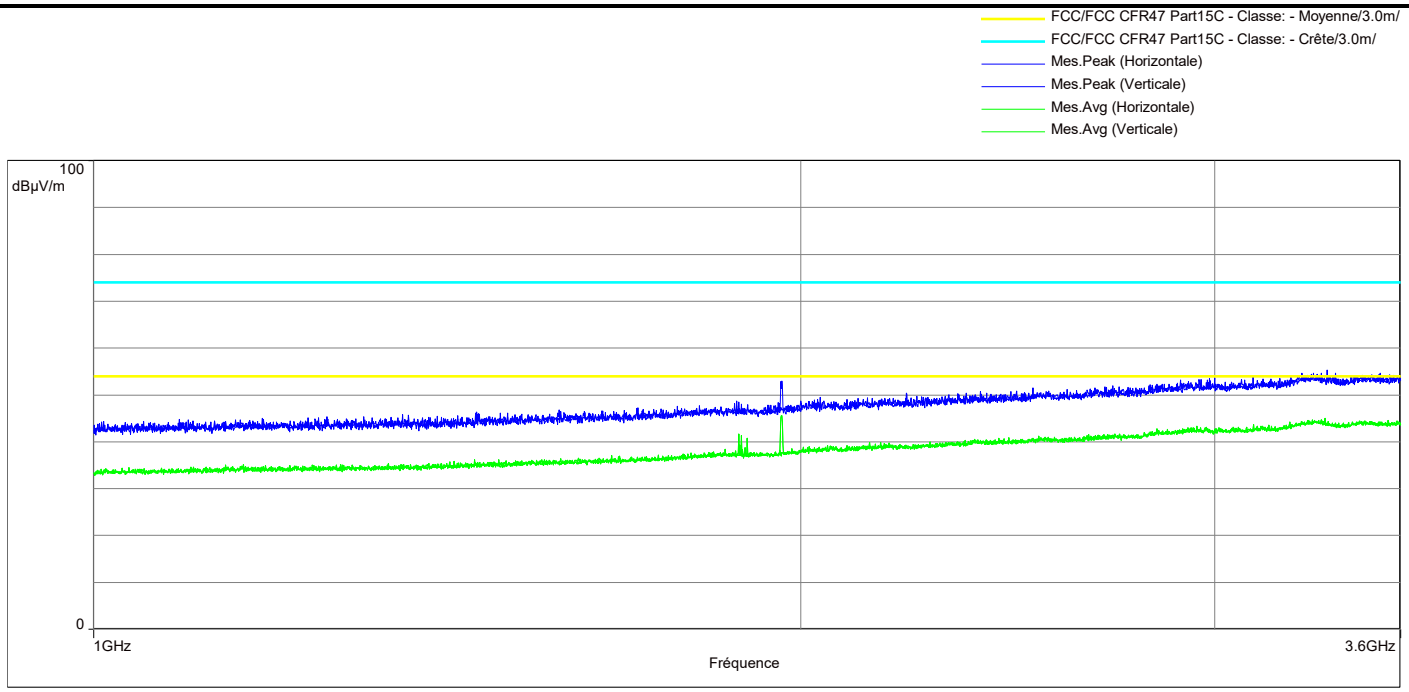
RADIATED EMISSIONS			
Graph name:	Emr#7	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V)[1-3.6]GHz - Axis XY	
Class:			
Frequency range: [1GHz - 3.6GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	1MHz
Azimuth:	0° - 360°	**VBW :**	3MHz



Spurious emissions

Test Frequency (MHz)	Meter Reading dB(µV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Transducer Factor (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
3325.70	72.5	Av	V	0	150	-28.7	43.8	54.0	**-10.2**
3499.90	71.7	Av	V	0	150	-28.2	43.5	54.0	**-10.5**
3325.70	84.0	Pk	V	0	150	-28.7	55.3	74.0	**-18.7**
3499.90	83.2	Pk	V	0	150	-28.2	55.0	74.0	**-19.0**

RADIATED EMISSIONS			
Graph name:	Emr#8	**Test configuration:**	
Limit:	FCC CFR47 Part15C	(H+V)[1-3.6]GHz --Axis Z	
Class:			
Frequency range: [1GHz - 3.6GHz]			
Antenna polarization:	Horizontal & Vertical	**RBW :**	1MHz
Azimuth:	0° - 360°	**VBW :**	3MHz



Spurious emissions

Test Frequency (MHz)	Meter Reading dB(µV)	Detector (Pk/QP/Av)	Polarity (V/H)	Azimuth (Degrees)	Antenna Height (cm)	Transducer Factor (dB)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
3527.72	71.9	Av	V	0	150	-28.1	43.8	54.0	**-10.2**
3350.14	72.0	Av	V	0	150	-28.7	43.3	54.0	**-10.7**
3527.72	82.8	Pk	V	0	150	-28.1	54.7	74.0	**-19.3**
3350.14	84.0	Pk	V	0	150	-28.7	55.3	74.0	**-18.7**

9. UNCERTAINTIES CHART

Type de mesure / *Kind of measurement*	**Incertitude élargie laboratoire / *Wide uncertainty laboratory* (k=2) ± x**	**Incertitude limite du CISPR / *CISPR uncertainty limit* ± y**
Mesure des perturbations conduites en tension sur le réseau d'énergie *Measurement of conducted disturbances in voltage on the power port*	3.51 dB	3.6 dB
Mesure des perturbations conduites en tension sur le réseau de télécommunication *Measurement of conducted disturbances in voltage on the telecommunication port.*	3.26 dB	A l'étude / Under consid.
Mesure des perturbations discontinues conduites en tension *Measurement of discontinuous conducted disturbances in voltage*	3.45 dB	3.6 dB
Mesure des perturbations conduites en courant *Measurement of conducted disturbances in current*	3.09 dB	A l'étude / Under consid.
Mesure du champ électrique rayonné sur le site en espace libre de Moirans *Measurement of radiated electric field on the Moirans open area test site*	5.20 dB	6.3 dB

Les valeurs d'incertitudes calculées du laboratoire étant inférieures aux valeurs d'incertitudes limites établies par la norme, la conformité de l'échantillon est établie directement par les niveaux limites applicables. / *The uncertainty values calculated by the laboratory are lower than limit uncertainty values defined by the standard. The conformity of the sample is directly established by the applicable limits values.*